

Before the
FEDERAL COMMUNICATIONS COMMISSION
 Washington, D.C. 20554

2-1999

In the Matter of)	
)	
The Establishment of Policies)	IB Docket No. 99-81
and Service Rules for the Mobile)	
Satellite Service in the 2 GHz Band)	

To: The Commission

**COMMENTS OF TITAN WIRELESS
 REGARDING SERVICE TO RURAL AND UNSERVED AREAS**

I. Introduction

Titan Wireless ("Titan") is pleased to respond to the Notice of Proposed Rulemaking concerning the request to address the need for service to rural and unserved areas.¹ Titan is engaged in community telephone and data communications and has a keen interest in the development of rural telephony services. Furthermore, Titan has designed a very small aperture terminal ("VSAT") system that is capable of remedying the domestic rural telecommunications situation today.

In 1995, Titan entered into a partnership with an Asian corporation to address the market for rural telephony in Indonesia and the rest of the Asia Pacific region. This joint venture resulted in the development of one of the largest and most cost-effective rural telephony networks in the world. Although Titan is not commenting on Mobile Satellite Service in the 2GHz band, we are responding to the Commission's inquiry concerning the adoption of similar policies for other satellite services. Titan urges the Commission to pursue the adoption of policies that allow community telephony providers to service domestic customers. This would not only further the Commission's goal of universal service but it would also increase competition between communications providers.

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 List A B C D E

¹ In re: *Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, Notice of Proposed Rulemaking (FCC 99-50), IB Docket No. 99-81, RM-9328 (released March 25, 1999).

II. Discussion

A. Background

Satellites are an excellent technology for delivering basic and advanced telecommunication services to unserved, rural, insular or economically isolated areas, and, today, Titan has an inexpensive, flexible and robust system using VSAT technology to address this need. The system is designed to operate with C band or Ku band fixed satellite service satellites and to provide seamless interconnection with the public telephony network. The system is also designed to provide least-cost routing of calls to strategically located Gateway interconnection points. As a result, very competitive pricing can be offered to these areas.

To fulfill this need the system requirements consists of the following:

- The rural terminal must provide voice, facsimile, and data capability.
- The terminal must be capable of being installed in rugged terrain in a very short time without the use of any special tools or test equipment.
- The terminal must be designed to operate in rugged climates without the need for a cooling fan or for routine maintenance (such as adjustments or calibration).
- The terminal must be of a low power design to allow for very low cost solar power operation in applications lacking a local power source.
- The system must interconnect to the public switched telephone network ("PSTN"), and billing data must be in a format that is interoperable with local Telecom organizations.
- The system must use satellite channel resources efficiently and must maintain positive control of the channel. (That is, the network control system ("NCS") must be able, whenever necessary, to reach any rural terminal and to receive responses.)

B. Implementation

To implement this capability in the United States and its territories, and to fulfill the Commission's policy of encouraging service to rural and other high-cost areas,² the Commission's support in the following areas would be needed: (1) interconnection with the PSTN, (2) access to funding through the universal service fund, (3) coordination of space segment frequency and expeditious authorization of earth stations, and (4) the availability of extended C band frequencies.

² *In re: Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, Notice of Proposed Rulemaking (FCC 99-50), IB Docket No. 99-81, RM-9328, p. 95 (released March 25, 1999).

1. Interconnection

It is important that the Commission assist with the interconnection to the PSTN in order to ensure seamless transition from the VSAT network to the PSTN. Congress directed the Commission to devise methods to ensure that consumers in all regions of the nation, including rural and high-cost areas, have access to similar telecommunications services.³ By ensuring a seamless transition from the VSAT network to the PSTN, it allows VSATs to provide the same level of reliable service as Americans receive in more populated areas. Furthermore, although Titan is unsure of all the possible interconnection issues at this time, the Commission's assistance with interconnection will help to avoid potential conflict between local carriers and VSAT providers of services to rural areas.

2. Access to Funding

The Telecommunications Act of 1996 requires the Commission and the states to ensure that affordable, quality, telecommunications services are available to all Americans,⁴ and the Commission addressed this with Universal Service Order.⁵ This order established that eligible common carriers would receive federal universal support. Because supplying rural and other high-cost areas with quality telecommunications services requires high up-front cost, Titan urges the Commission to assist suppliers with access to funding through the universal service fund.

3. Coordination of Spectrum Frequency and Expeditions Authorization of Earth Stations

Coordination of space frequency and expeditious authorization of earth stations are also relevant issues involved in fulfilling the Commission's policy of encouraging service to rural and other high-cost areas. The orbital slots are saturated with users and there are many various service providers competing for spectrum. For VSAT communications suppliers to install rural telephony without undue delay it is imperative that the Commission assists in coordinating the use of domestic frequencies. This goes hand in hand with the Commission's expeditious authorization of earth stations because undue delay will not only cost suppliers money, it will also prevent residents of rural areas, such as Native American reservations, from receiving essential telecommunications services.

4. Inclusion of Extended C Band

The inclusion of extended C band frequencies is also important to implement an affordable and quality telecom service. By giving rural VSAT telephony service providers additional spectrum options, such as extended C band, it will allow VSAT manufacturers the flexibility to employ a myriad of technical solutions to the rural

³ 47 U.S.C. § 254(b)(3).

⁴ *Commission Implements Telecom Act's Universal Service Provisions*, CC Docket No. 96-45, Report No. CC 97-24 (released May, 1997).

⁵ *Universal Service Order*, Report and Order (FCC 97-157), CC Docket No. 96-45, (released May 8, 1997).

communication issues. Because technical employment of services would not be dictated by limited frequency availability, this flexibility will allow VSAT communications providers the ability to provide services in the most equitable and cost-effective manner.

C. Pricing

The cost of a rural communications terminal would be between \$3,000 and \$5,000 with a typical per minute cost of 10-15 cents. This price, however, would be dependent upon various factors including the source of power (e.g. solar or traditional), whether there is access to the PSTN, training costs, etc.


III. Conclusion

In conclusion, Titan encourages the Commission to pursue the adoption of policies that will encourage rural telephony service. This will allow for greater universal access and competition among providers. Furthermore, Titan has an inexpensive and flexible system that has the ability to supply rural areas today with high quality telecommunication services. Titan urges the Commission to assist in interconnection, access to funding, coordination of spectrum frequencies and expeditious authorization of earth stations, and the availability of extended C band frequencies.

The attached technical paper and brochures describe Titan's solution to this very important issue.

Respectfully submitted,

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VERY SMALL APERTURE TERMINAL TECHNOLOGY FOR RURAL TELEPHONY APPLICATIONS

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INTRODUCTION

The current dynamic economic growth within Asia Pacific has spawned new opportunities for alternate forms of communications. This region has a combined population of more than three billion people; yet, owing to the lack of available telephony infrastructure, the majority of the population has no access to telecommunications service. Very small aperture terminal (VSAT) technology can provide a practical solution to the rural telephony problem for countries with underdeveloped communications infrastructures seeking rapid modernization.

In 1995, Pasifik Satelit Nusantara (NASDAQ: PSNRY) of Jakarta, Indonesia, and Titan Information Systems Corporation (NYSE: TTN) of San Diego, California (USA), entered into a partnership to address the market for rural telephony in Indonesia and the rest of the Asia Pacific region. This joint venture has resulted in the development of one of the largest and most cost-effective rural telephony networks in the world. Initiation of this project required that Pasifik Satelit Nusantara (PSN) and Titan participate in a joint requirements analysis effort to optimize the cost and operational effectiveness of the network. The project required that the terminal functions be allocated efficiently between the network control and the rural terminal hardware to obtain the most cost-effective design.

The principle set of system requirements consists of the following:

- The rural terminal must provide voice, facsimile, and data capability.
- The terminal must be capable of being installed in rugged terrain in a very short time without the use of any special tools or test equipment.
- The terminal must be designed to operate in the rugged tropical climates of Asia without the need for a cooling fan or for routine maintenance (such as adjustments or calibration).
- The terminal must be of a low power design to allow for very low cost solar power operation in applications lacking a local power source.
- The system must interconnect to the public switched telephone network (PSTN), and billing data must be in a format that is interoperable with local Telcom organizations.
- The system must use satellite channel resources efficiently and must maintain positive control of the channel. (That is, the network control system (NCS) must be able, whenever necessary, to reach any rural terminal and to receive responses.)

Achieving the goals of this project required the streamlining of traditional design functions for a VSAT terminal and network control system. In particular, we oriented the VSAT functions toward personal communications. We achieved design-to-cost thresholds for the terminal by using mass-produced technologies and high-level integration wherever possible. Extensive tradeoffs in the system design were performed both to optimize system performance and to minimize terminal hardware complexity.

The rest of this paper describes the implementation of the Xpress Connection™ System by Titan.

The Xpress Connection™ System is designed to provide the user full and reliable functionality at a low cost. Since the system minimizes power utilization, user terminals consume less than 30 watts of power over the complete duty cycle. Users can achieve solar operations with minimal investment in additional equipment. Installation is simple and efficient, requiring no special tools or test equipment. The indoor unit is used to assist in peaking the antenna. The system aids the installer by providing automated feedback during antenna peaking in the form of downlink power readings for coarse tuning and end-to-end E_b/N_0 measurements for fine tuning. The antenna can be installed using either a pole or a non-penetrating roof mount. The outdoor units perform all the signal and baseband processing. The heat dissipation of the outdoor unit is such that the system requires no fans and has no moving parts. The indoor units provide for the connection for a telephone, facsimile, or data device with a display.

System operation is also simple. To place a telephone, facsimile, or modem call, the user dials the number just as he or she would when using a terrestrial phone line. Signaling originated at the PSTN is relayed to the end user just as in a terrestrial phone line. Calls are terminated by simply going back on hook. For calls originating at a rural terminal, routing is automatically performed based on the number the user has dialed. To minimize problems with traffic congestion, the system provides three levels of alternate routing. These routings usually go to unmanned gateways located at population centers.

SYSTEM OVERVIEW

The Xpress Connection™ System contains three types of terminal: rural telephony terminals (RTTs), gateways, and a central network control station. Figure 1 illustrates the system. The RTTs consist of a single 1.2 meter pole or roof-mount antenna, an outdoor unit, and an indoor operator display. The indoor operator display has RJ11 and RS-232 connectors for telephone and computer connection.

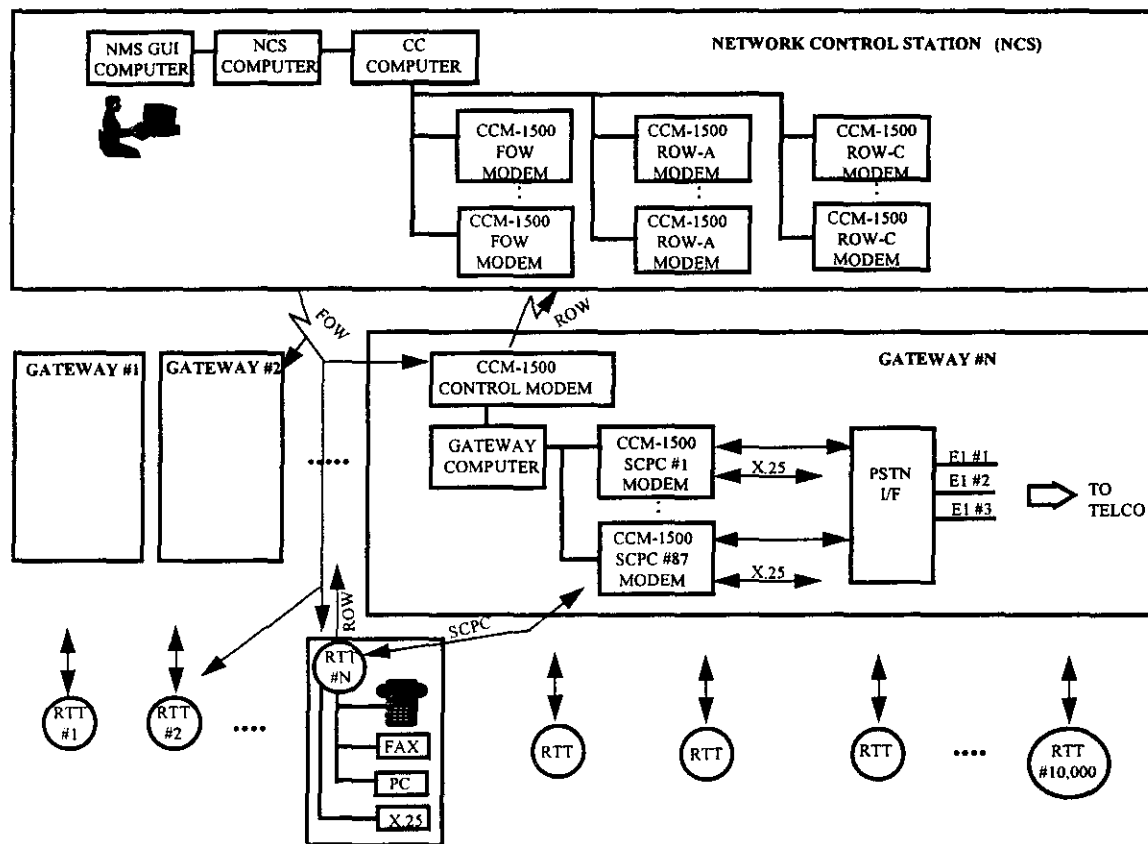


Figure 1. Xpress Connection™ Block Diagram

The gateway consists of control modems connected to a control computer. The control computer is connected to multiple channel modems as well as to a PSTN interface or data router. The channel modems are also interfaced to either the PSTN interface or data router. The channel modems are demand assigned to synchronize with RTTs and transfer data between rural and public network users.

The NCS consists of a bank of control modems connected to a concentrator computer. The control modems receive requests and status from the RTTs as well as the gateways. This inbound data is transmitted in scheduled time slots referred to as return orderwire (ROW). The ROW data is passed through the concentrator computer to the network control computer (NCC). The NCC prioritizes the requests and assigns resources. The resource assignments are passed back to the concentrator computer, which schedules them for transmission to the gateways and RTTs on continuous channels referred to as forward orderwire (FOW) channels.

The NCS is also connected to a network management computer that provides convenient graphical interfaces for the following functions:

- monitoring each system element
- collecting billing data
- defining system resources
- establishing network policy

Xpress Connection™ CHANNELIZATION

Since all Xpress Connection™ channels are 30 kHz wide, the channel packing algorithm is simplified. Xpress Connection™ utilizes three types of channels:

- Single channel per carrier (SCPC) FOW channels
- Time division multiple access (TDMA) ROW channels
- SCPC user data channels

SCPC FOW Channel

The SCPC FOW channels are continuous broadcast channels that the gateway channel control modems monitor continuously and the RTTs monitor when not involved in a service. The waveform for the FOW channels contains both a preamble that is transmitted every 1/12 of a second and the capacity for 4,524 bits per second (bps) for broadcasting assignments. Figure 2 depicts the SCPC FOW channel waveform. Each channel assignment requires 39 bits of FOW capacity.

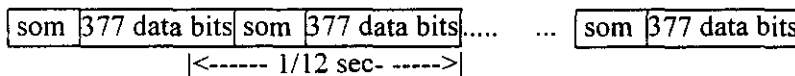


Figure 2. SCPC FOW Channel Waveform

TDMA ROW Channel

The TDMA ROW channel is partitioned into 1/12 second slots. The gateways and RTTs transmit in these slots to report status, acknowledge assignments, and make requests for services. The control modems at the NCS monitor these channels. The ROW bursts contain a preamble for fast acquisition and up to 153 bits of data and guard time to compensate for errors in position data. If the NCS either 1) assigns a service that requires acknowledgment from a gateway or RTT or 2) polls an RTT or gateway for status, the NCS assigns a ROW slot. However, if a gateway or RTT has a ROW queued for transmission but has not received a ROW slot assignment, the gateway or RTT selects the ROW slot randomly from the pool of available and unassigned ROW slots. Figure 3 depicts the TDMA ROW channel waveform. Each control channel can receive 12 ROW slots per second.

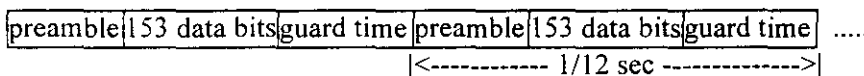


Figure 3. TDMA ROW Channel Waveform

SCPC User Data Channel

The SCPC data channels are assigned as pairs to provide full duplex services. Each channel contains a single preamble followed by continuous data. These channels relay data between the gateways and the RTTs. In addition to voice, fax, or serial data, the SCPC channel contains control data. The control data portion is used for the gateways and RTTs to exchange status requests and status data. Every 32 subframes of user and control data, a start of message (SOM) is transmitted. The SOM aids in reacquisition of the signal in the event a modem loses synchronization in the middle of a service. Figure 4 depicts the SCPC user data channel waveform.

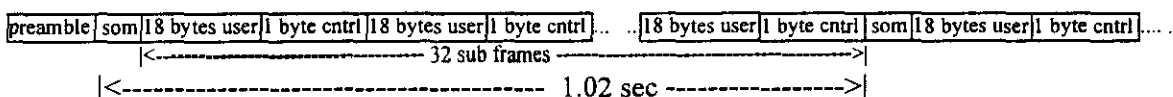


Figure 4. SCPC User Data Channel Waveform

Xpress Connection™ CIRCUIT SETUP and TEARDOWN PROTOCOL

Figure 5 depicts the channels used to set up and tear down circuits. Circuit setup requires the sending of one contention ROW slot to set up the service. If the call is RTT-originated, the ROW is sent from the RTT; if the call originates in the PSTN, the ROW is sent from the channel control modem at the gateway. The FOW channel is used to assign the RTT and the gateway to a channel and to assign a ROW slot to the gateway, thereby acknowledging the assignment.

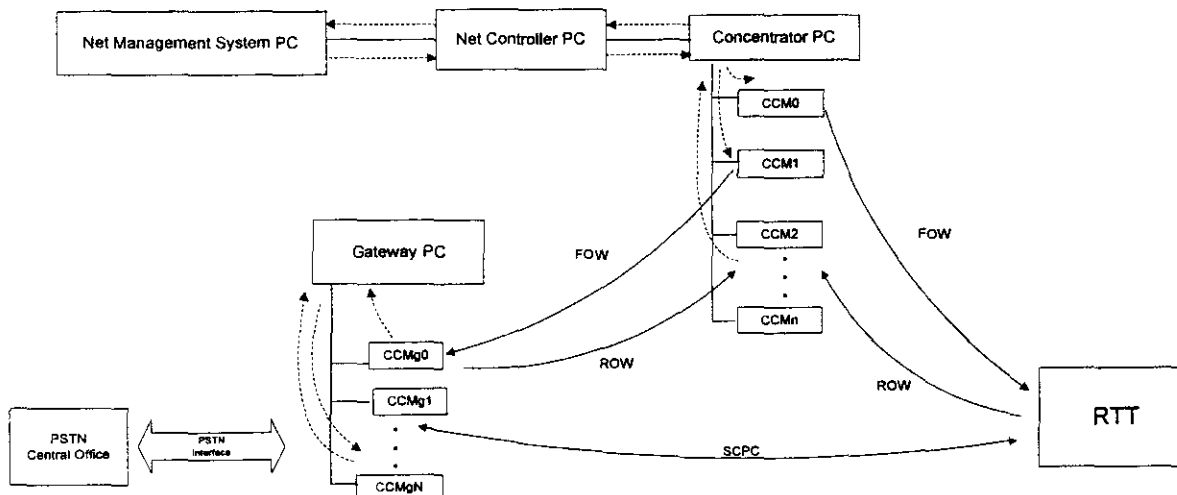


Figure 5. Xpress Connection™ Data Flow

If an RTT is involved in a circuit and is still synchronized with an SCPC modem at a gateway at the time the RTT user goes on hook, the RTT sends a teardown request through the SCPC modem to the gateway. However, whether the teardown originates at the gateway or at the RTT, the gateway uses a single ROW to request the circuit teardown. The NCS uses the SCPC FOW channel to send the billing data, to tear down assignment to the gateway, and to assign a ROW slot to the gateway. The gateway sends the billing data on to the RTT. The RTT then terminates

transmission and tunes to a FOW channel to resynchronize with the NCS. The SCPC modem at the gateway ceases to transmit, and, using the assigned ROW slot assignment, the gateway acknowledges the teardown assignment.

If synchronization is lost at the RTT, the RTT reacquires an SCPC FOW channel and sends a teardown request ROW in a random access TDMA slot. The NCS then uses an SCPC FOW channel to acknowledge the RTT teardown request and to send a teardown command together with an assigned ROW slot to the gateway. If the SCPC modem loses synchronization at the gateway, the gateway uses a random access TDMA slot to tear down the call. At that point, the RTT loses synchronization and times out. It then reacquires the SCPC FOW channel and sends a teardown. The NCS uses the SCPC FOW channel to acknowledge the RTT teardown.

CONCLUSION

For countries with underdeveloped communications infrastructures seeking rapid modernization, the technology that drives the Xpress Connection™ communications system offers a practical and cost-effective solution. The advanced technology employed in this system has been proven to provide reliable and affordable telecommunications for areas of the world such as Indonesia with its widespread population and island geography.